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(71) Applicant: CAMBRIDGE INDUSTRIES, INC. [US/US]; 555 Horace Brown Drive, Madison Heights, MI 48071 (US).

(72) Inventor: HORTON, Gregory; Apartment 107, 1675 East Thirteen Mile Road, Madison Heights, MI 48071 (US).

(74) Agent: PERMUT, Steven, L.; Reising, Ethington, Barnes, Kisselle, Learman and McCulloch, P.O. Box 4390, Troy, MI 48099 (US).

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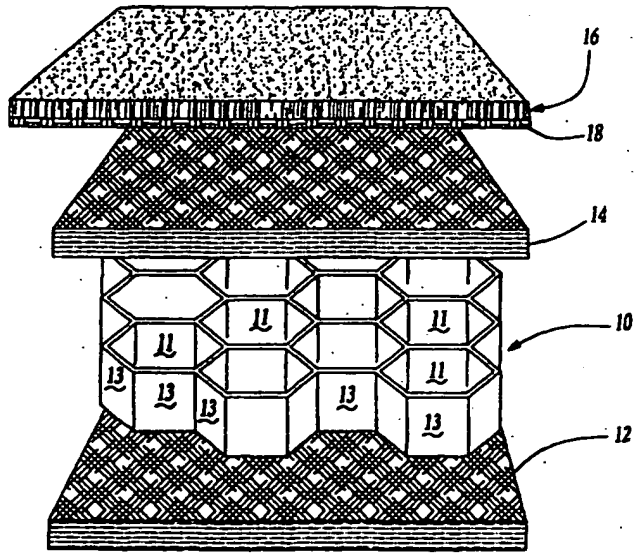

(57) Abstract

An automotive structural member (26) is made from a heated bottom layer (12) and upper layer (14) of a balanced weave of woven glass and polypropylene bonded to a core layer (10) of a honeycomb lattice made from polypropylene. The upper and lower layers are heated to provide a molten state to the polypropylene and the lower and upper layers are laid in a mold with the core layer. The mold is closed and a low pressure is applied to bond the lower and upper layers to the core layer. After cooling, the mold is then opened and the molded structural member (26) is then removed.

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A MOLDED AUTOMOTIVE STRUCTURAL MEMBER AND PROCESS FOR MAKING SAME

TECHNICAL FIELD

The field of this invention relates to a molded automotive structural member for use with automotive interiors and exteriors and a molding process for making such an automotive structural member.

BACKGROUND OF THE DISCLOSURE

Automotive interiors and exteriors have many panels and members that form the door panels, floor panels, bumper fascias and rear deck storage panels. Many of these panels and structural members need to be structurally sound and light weight and expeditiously made from readily accessible materials. Furthermore these products need to be made from environmentally friendly materials. Any plastics need to be recyclable.

The structurally sound panels also need to have certain predetermined thickness. While many panels are 25 millimeters in thickness, solid plastic would create excessive weight. However, structural strength or rigidity needs to be incorporated in any lighter structure and be able to withstand and distribute any applied stress.

Composite sandwiched members have been manufactured by laminating a top layer to a bottom

layer with adhesive material. This process is time consuming and labor intensive.

What is needed is a composite layered structure that has a light weight structural core molded to outer solid reinforced plastic layers.

SUMMARY OF THE DISCLOSURE

In accordance with one aspect of the invention, a process for forming an automotive structural member includes providing a bottom layer of a heated flexible mat material having a substantial content of thermoplastic material, a core layer of structurally rigid thermoplastic material constructed with many pockets of space in the form of a foam or lattice, and an upper layer of heated flexible mat material having a substantial content of thermoplastic material. The heated bottom layer, core layer and heated upper layer are placed into an open mold in their sandwiched layered positions. The mold is closed and the bottom layer, core layer and upper layer are molded under pressure between two closed mold dies until cooled when the thermoplastic material in the bottom layer, core layer and upper layer is resolidified to bond the bottom and upper layers to the core layer. The mold dies are then opened and the molded structural member is then removed from the mold die.

Preferably, the core layer is in the form of a lattice and most desirably in the form of a honeycomb shaped lattice with walls extending from the bottom layer to the upper layer. It is also preferred that at least one of the bottom and upper layers includes reinforcing glass fibers. It is desirable that the glass fibers are in the form of a woven mat. It is also preferred that the thermoplastic material in each layer is polypropylene.

In accordance with another aspect of the invention, an automotive structural member includes bottom and upper layers made from a mat material having a substantial content of thermoplastic material and a core layer made from a structurally rigid thermoplastic material constructed with many pockets of space in the form of a foam or lattice. Preferably the thermoplastic in the bottom , core, and upper layers is polypropylene. The bottom layer, core layer, and upper layer are molded together in an integrated form by molding under pressure between two closed mold dies to bond the bottom and upper layers to the core layer.

It is preferable that the core layer is a honeycomb lattice with walls extending from the bottom layer to the upper layer. It is also preferred that at least one of the bottom and top layers includes reinforcing glass fibers where it is preferred that the fibers are in the form of woven glass.

In one embodiment, the upper layer is topped with a layer decorative material such as of thermoplastic backed carpet with said decorative layer being molded with and forming part of the automotive structural member.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference now is made to the accompanying drawings in which:

Figure 1 is an exploded perspective view of layers for a composite molded panel article;

Figure 2 is a schematic side elevation view of an open mold with the layers shown in figure 1;

Figure 3 is a view similar to figure 2 illustrating the mold dies moved to a closed position;

Figure 4 is a fragmentary segmented view of the molded article removed from the mold shown in figure 3; and

Figure 5 is a view similar to figure 4 illustrating an alternate embodiment in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to figure 1, a core layer 10 is shown that is made from polypropylene and having a honeycomb lattice structure with spaces 11 incorporated

therein surrounded by vertically oriented walls 13. The core layer 10 is interposed between two layers 12 and 14 of a balance weave of a blend of glass fibers and polypropylene. Depending on the application, the glass content may vary from 50% to 75% content in the layers 12 and 14. A carpet layer 16 with a polypropylene backing 18 is adjacent upper layer 14.

The layers 12 and 14 are heated to a surface temperature of 400° degrees F such that the polypropylene is in a molten moldable state throughout its thickness. Optionally, the core layer 10 and carpet 16 may also be heated for increased moldability in certain applications. The layers 12, 10, 14, and carpet 16 are then transferred to an unheated mold assembly 20. The mold assembly 20 has a lower mold die 22 and complementary upper die member 24.

The layers are placed in order with the bottom layer 12, core layer 10, upper layer 14 and carpet 16. The mold assembly is then closed as shown in figure 3 immediately after the layers 10, 12, 14, and 16 are correctly positioned therein. The heat from the layers 12 and 14 undergoing low pressure from the mold assembly bonds the layers 12 and 14 to the honeycomb lattice core layer 10 and the polypropylene backing 18 of the carpet layer 16 to upper layer 14. The walls 13 of honeycomb lattice core layer 10 extend from the bottom layer 12 to the upper layer 14.

The mold dies are at ambient temperature and not heated by any source other than what heat the layers 12, 10, and 14 transfers to the mold dies. A conventional cooling mechanism (not shown) dissipates excess heat from the mold assembly. A minimal low pressure of 5 bars provides sufficient compressive force to achieve part configuration and bonding of the layers within the mold assembly.

The mold assembly remains under pressure until the polypropylene resolidifies which can, depending on the application and thickness of the materials, range between 30 and 140 seconds. The mold is then opened and a finished structural member 26 is formed as shown in figure 4.

An alternate embodiment is shown in figure 5. In this structural member 30, the core layer 32 is a polypropylene foam material with many irregularly positioned spaces 33 such as a foam or sponge has. This replaces the regularly positioned spaces in previously illustrated honeycomb lattice. Furthermore, this member 30 has no carpet layer. The member 30 only has core layer 32, bottom layer 10 and upper layer 14. The molding process outside of eliminating the carpet layer is identical to that previously described.

In this fashion, an expeditious process forms an automotive structural member such as an interior trim panel or exterior bumper. The member is

structurally self-supportive that can withstand stress and weight. Furthermore, the member may be recycled or otherwise made from recycled thermal plastic material. Furthermore, the structural member may have a cosmetic carpeted surface or other decorative material molded onto the member.

Other variations and modifications are possible without departing from the scope and spirit of the present invention as defined by the appended claims.

CLAIMS

The embodiments in which an exclusive property or privilege is claimed are defined as follows:

1. A process for forming an automotive structural member characterized by the steps of:

providing a bottom layer of a heated flexible mat material having a content of thermoplastic material;

providing a heated core layer of structurally supportive thermoplastic material constructed with many pockets of space in the form of one of a foam or lattice;

providing an upper layer of heated flexible mat material having a content of thermoplastic material;

placing the heated bottom layer, core layer and upper layer into an open mold;

closing the mold and molding said bottom layer, said core layer, and said upper layer under pressure between two closed mold dies until cooled and said thermoplastic material in said bottom, core layer and upper layers is resolidified to bond said bottom and upper layers to said core layer;

opening said mold dies and removing the molded formed structural member.

2. A process as defined in claim 1 further characterized by:

said core layer being lattice in the form of a honeycomb shape with walls extending from the bottom layer to the upper layer.

3. A process as defined in claim 1 further characterized by:

at least one of said bottom and upper layers including reinforcing glass fibers.

4. A process as defined in claim 3 further characterized by:

said fibers being in the form of woven glass.

5. A process as defined in claim 4 further characterized by:

said thermoplastic in said lattice, bottom, and upper layers being polypropylene.

6. A process as defined in claim 4 further characterized by:

said upper layer being topped with a layer of thermoplastic backed carpet with said carpet being

molded with and forming part of said automotive structural member.

7 A molded automotive structural member characterized by:

a bottom layer made from a mat material having a substantial content of thermoplastic material;

a core layer made from a structurally rigid thermoplastic material constructed with many pockets of space in the form of one of a foam or lattice;

an upper layer made from a mat material having a substantial content of thermoplastic material;

said core layer, bottom layer and upper layer being adhered in an integrated form by molding under pressure between two closed mold dies to bond said bottom and upper layers to said core layer;

8. An automotive structural member as defined in claim 7 further characterized by:

said core layer being a lattice having a honeycomb shape with walls extending from the bottom layer to the upper layer.

9. An automotive structural member as defined in claim 7 further characterized by:

at least one of said bottom and top layers including reinforcing glass fibers.

10. An automotive structural member as defined in claim 8 further characterized by:

said fibers being in the form of woven glass.

11. An automotive structural member as defined in claim 9 further characterized by:

said thermoplastic in said lattice, bottom, and upper layers being polypropylene.

12. An automotive structural member as defined in claim 10 further characterized by:

said upper layer being topped with a layer of thermoplastic backed carpet with said carpet being molded with and forming part of said automotive structural member.

13. An automotive structural member as defined in claim 10 further characterized by:

said upper layer being topped with a layer of decorative material with said decorative material being molded with and forming part of said automotive structural member.

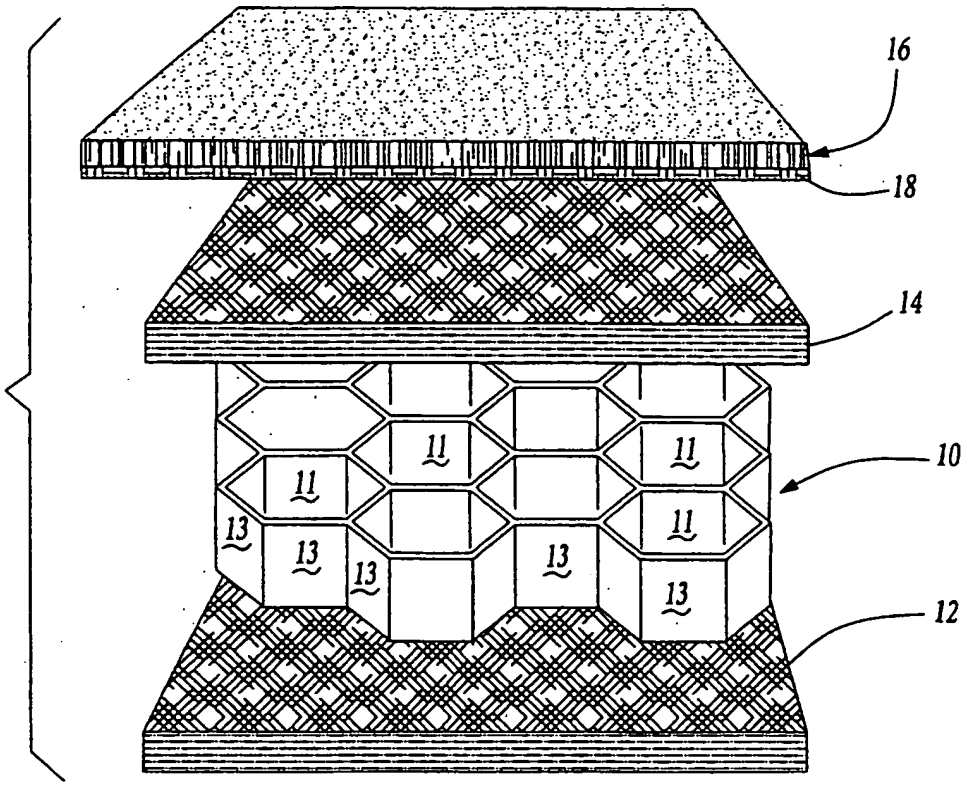

Fig-1

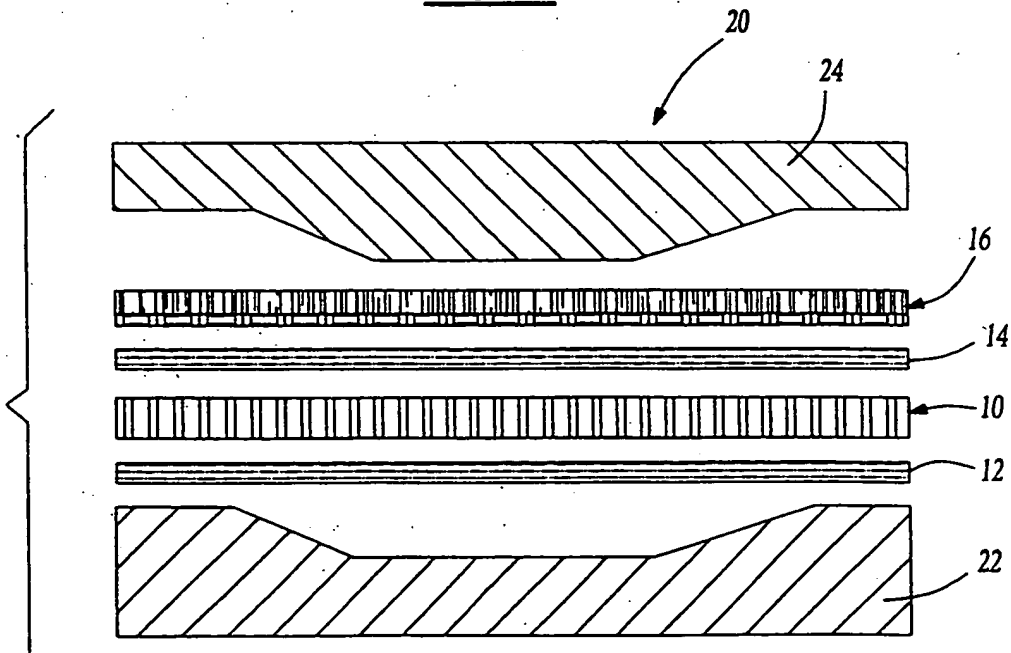

Fig-2

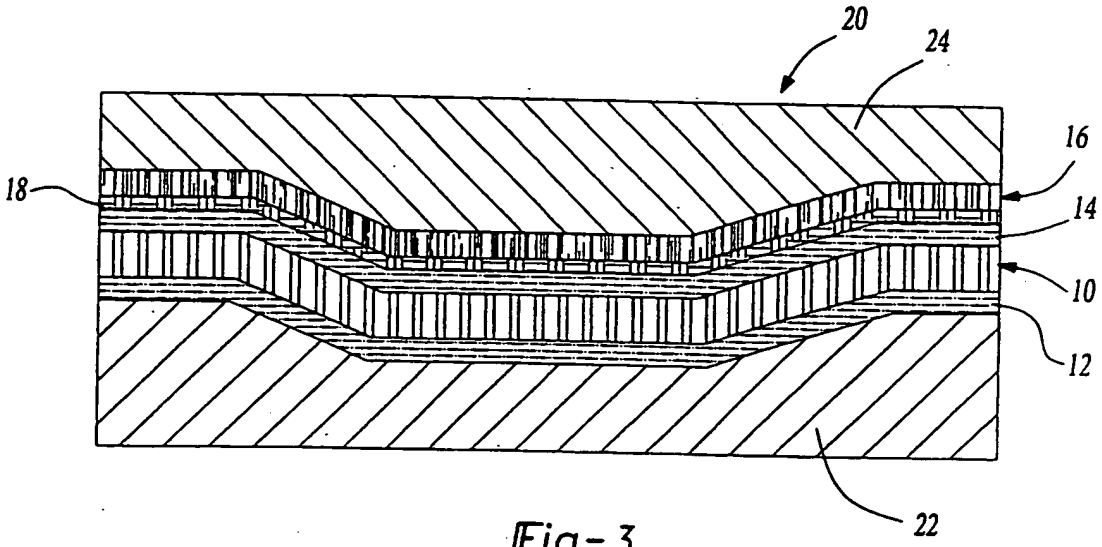

Fig-3

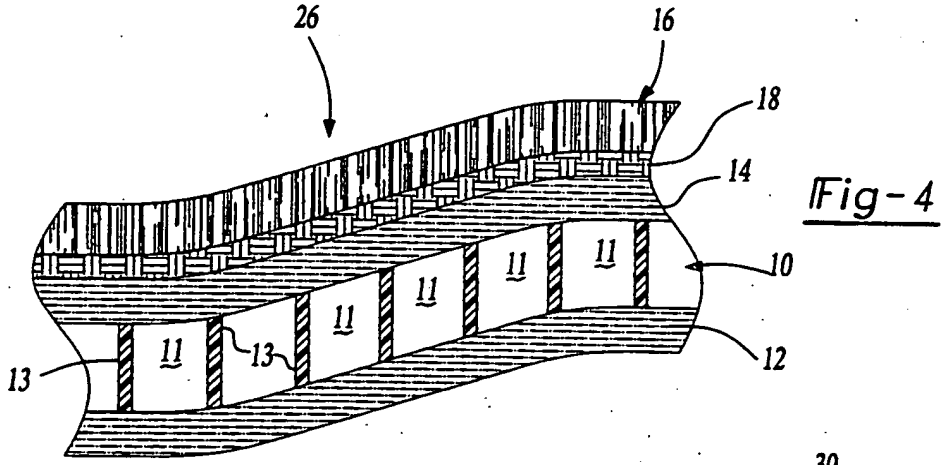

Fig-4

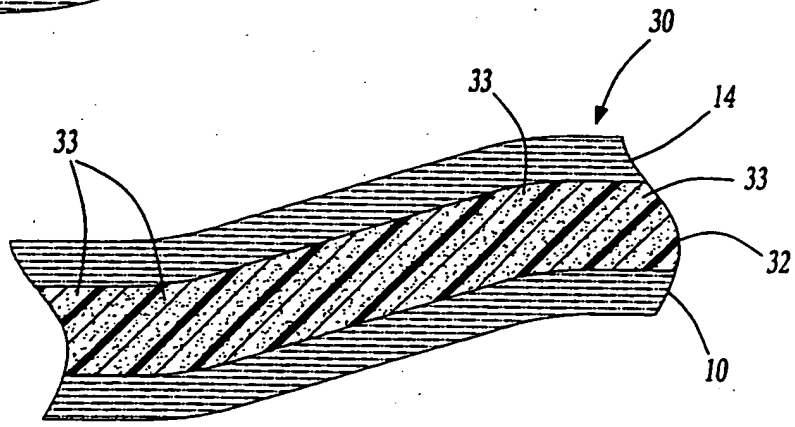

Fig-5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/23368

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : B29C 43/20
US CL :264/258
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 264/257; 156/182, 220, 224

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,087,500 A (KASPER et al.) 11 February 1992, see entire reference	7-9
Y	US 5,043,127 A (BRAMBACH) 27 August 1991, see entire reference	1-13
Y	US 4,315,050 A (ROURKE) 09 February 1982, col. 3, lines 15-21	1, 3, 5, 7
Y	US 5,238,725 A (EFFING et al.) 24 August 1993, see entire reference	1-13
A	US 4,013,810 A (LONG) 22 March 1977, see entire reference	1-13
Y	US 4,937,125 (SANMARTIN et al.) 26 June 1990, see entire reference	1-13

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Authorized officer
STEFAN STAICOVICI
Telephone No. (703) 308-0661

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